apparently executed with much care, and is stated to be the most accurate of its kind yet produced in Brazil. He has also published the first part of a work on the railways of Brazil in 1879, descriptive of the lines shown on the above-mentioned map, and he has added a skeleton map showing the railways only. Dr. Passos has, we believe, been induced to issue these publications in order to make more widely known in England the progress in railway communication now going on in Brazil, a subject which is of considerable interest from an economical and geographical point of view.

THE last *Bulletin* of the Antwerp Geographical Society contains a geographical and commercial essay on the Australian colonies, which is accompanied by reproductions of some curious old maps, as well as by a sketch map which professes to distinguish the arable, pastoral, and desert regions of the continent, in regard to which, however, the writer's information hardly appears to be brought down to the latest date.

FROM the Japan papers we learn that H.M.'s surveying vessel *Sylvia* left Hiogo on April 24 for Cape Chichakoff to take a line of soundings there, which will complete her surveying work on the Japanese coast. The *Sylvia* has been employed for about twelve years in surveying the coasts of Japan and the Inland Sea, and during this period has done excellent service to navigation.

M. DE UJFALVY is to leave Paris at the end of the summer on his new journey of exploration in Central Asia.

THE *Times* correspondent writes from Copenhagen that on June 24 died there Mr. Carl Petersen, whose name is connected with some of the most renowned Arctic explorations. He was a born Dane, but had lived many years in Greenland, and had there acquired a perfect knowledge of the Esquimaux language, being at the same time a most skilled hunter and fisherman. At the age of thirty-seven he was engaged by Capt. Penny as interpreter, and accompanied his expedition in the years 1850-51. Some years later he followed Dr. Kane on his unfortunate expedition, when the vessel had to be left in the ice and the crew were nearly starved and frozen to death. He had not been home more than a couple of weeks after returning from a two years' stay in Greenland, before he went out again as interpreter with the *Fox*, Capt. Sir Leopold M'Clintock, with Mr. (now Sir) Allan Young as sailing master. Of this expedition, lasting from 1857 to 1859, and leading to the discovery of the fate of Sir John Franklin, he has written a graphic description, supplying many details wanting in the well-known book of Sir L. M'Clintock, and inscribed with the words chosen by Jane Franklin for the flag of the *Fox*, "Hold fast," happening to be quite as correct in Danish as in English. In 1861 he accompanied the Swedish naturalists Nordenskjöld and Torell on their first expedition to Spitzbergen, and when, in last April, the *Vega* passed Copenhagen, the hardy old sportsman and sailor, with his cross and Arctic medal, was one of the friendly faces greeting the discoverer of the North-East Passage. Mr. Petersen died from heart-disease at the age of sixty-seven.

PHYSICAL NOTES

ONE of our electrical contemporaries across the Channel gives a glowing description of *une grande machine électrique allemande*, which its editor says he wishes to see introduced into France, "where our official professors appear to have lost all ambition at making things big." The great gooseberry of the season is nothing to this new machine, which is, we are told, composed of twenty parallel disks of 1,300 metres in radius. This is "making things big" with a vengeance, for the diameter of the disks will be over 2½ kilometres, or about a mile and a half. Did our contemporary make a double blunder when it wrote "*treize cents mètres*"? If we remember rightly, the plates in Töpler's induction-machine, which appears to be the one referred to, are not far from 13 centimetres radius.

PROFESSORS BRACKETT AND YOUNG have made a new determination of the efficiency of Edison's dynamo-electric generator and of his carbon horse-shoe lamp, and find that one horse-power applied at the dynanometer would produce in this lamp a light equal to that of 107 standard candles. As a matter of fact the lamp was only giving a light of 10·7 candles while consuming 0·077 of a horse-power, which is not quite the same thing.

PROF. QUINCKE has lately been occupied with a very remarkable research on the alteration of volume which a dielectric experiences under the stress of an electric charge. In most cases the result of surface electrification is to produce a minute expansion, but one class of bodies—that of the fatty oils and resins—contracts under similar circumstances. Herr Quincke applies his measurements to explain the phenomena observed by Kerr of the double refraction of light exhibited by dielectric media when under electrostatic strain; and he shows that the optical effects in the two classes of media are opposite in character.

M. MOUCHET is continuing in Algeria the researches on the utilisation of solar heat which he began in the South of France. He employs, according to his recent communication to the *Comptes Rendus*, a mirror 3·8 metres in diameter to concentrate the rays of the sun upon a boiler of copper 5 millims. thick. Even on dull days the apparatus boils water under half an hour. M. Mouchet has employed his apparatus for the distillation of oils and essences, the boiling of linseed oil, and the sublimation of benzoic acid. He has even succeeded in working a small engine.

MR. G. R. CAREY of Boston has published in the *Scientific American* a suggested system for the transmission of light by electricity. A camera throws an image of the object to be exhibited upon a surface made up of small pieces of selenium, each of which forms part of a separate voltaic circuit, the circuits passing to a receiving instrument, where they reproduce the image by incandescence. To this Mr. Sawyer has appended the following criticisms:—The action of light in altering the conductivity of selenium is slow. To transmit satisfactorily an image one inch square would require 10,000 selenium points and 10,000 conducting wires, unless some principle of isochronous movement could be devised—which Mr. Sawyer regards as unattainable in practice.

M. FAYE has lately published in the *Comptes Rendus* a remarkable paper on the physical forces which have produced the present figure of the earth. After remarking on the use of the pendulum in determining the figure of the earth from series of measurements of the intensity and direction of the gravitation force at different parts of the earth's surface, he draws attention to the curious fact that while the direction and intensity of gravity are affected perceptibly by the presence of hills such as Schiehallion and Arthur's Seat, or even by masses as small as the Great Pyramid of Gizeh, gigantic mountains such as the Himalayas, and great elevated plateaux and table-lands do not affect the pendulum-indications in any sensible manner, except in certain cases where upon elevated continents there appears to be a veritable defect of attraction instead of the excess which might be expected. Indeed, the observations are sufficiently striking to seem to point to the supposition that not only under every great mountain, but even under the whole of every large continent, there were enormous cavities. More than this, the attraction at the surface of all the great oceans appear too great to agree with the distribution presumed by Clairant's formula, which is exact enough for most purposes. Sir G. Airy's suggestion that the base of the Himalaya range reaches down into the denser liquid interior, and there displaces a certain amount of that liquid, so that the exterior attraction is thereby lessened, is one which, inherently improbable, fails to have any application in explaining why the attraction above the seas should be greater than over the continents. M. Faye propounds the following solution to the difficulty:—*Under the oceans the globe cools more rapidly and to a greater depth than beneath the surface of the continents.* At a depth of 4,000 metres the ocean will still have a temperature not remote from 0° C., while at a similar depth beneath the earth's crust the temperature would be not far from 150° C. (allowing 33 metres in depth down for an increase of 1° in the internal temperature). If the earth had but one uniform rate of cooling all over it, it would be reasonable to assume that the solidified crust would have the same thickness and the same average density all over it. It is therefore argued that below the primitive oceans the earth's crust assumed a definite solid thickness before the continents, and that in contracting, these thicker portions exercised a pressure upon the fluid nucleus tending to elevate still further the continents. This hypothesis, M. Faye thinks, will moreover explain the unequal distribution of land and sea around the two poles; the general rise and fall of continents being determined by the excess of density of the crust below the oceans, and by the lines or points of least resistance to internal pressure being at the middle of continents or at the margin of the oceans.

SOME experiments have lately been made by the Rev. Dr. Haughton and Prof. Emerson Reynolds to evaluate the coefficient of friction (*i.e.* the "drag") of air upon air and of water upon water. In these experiments a spherical ball of unpolished granite of 22 kilogrammes weight and 25 centimetres in diameter was suspended freely by a pianoforte wire and was set rotating in the air or in water; the period of the vibrations and the decrement of their amplitudes being observed by means of indices attached to the brass collar by which the ball was suspended. A discussion of the equations of motion led to a simple working equation for reduction of results. The mean coefficient of friction found for air upon air was $f = \frac{1}{6052{\cdot}7}$, though this value apparently differed slightly according to barometric and thermometric conditions. For the "drag" of water upon water the value found was $f = \frac{1}{307}$. These experiments involved friction at low velocities only, for which it could be assumed that the friction was proportional to the velocity. The authors of this research point out that these results tend to negative the theory of Dr. Carpenter that the phenomena of ocean circulation are due to the greater height of the water at the equator as compared with that at the poles.

FROM a series of experiments with tones produced by a limited number of impulses, Herr Kohlrausch finds (*Wied. Ann.*, No. 5) that a tone of only two vibrations of a certain frequency can be distinguished as differing in pitch from a continuous tone, when it forms with it an interval of $\frac{2}{3}\frac{4}{5}$. Also, in agreement with the researches of Herr Exner and Herr Auerbach, the possible sharpness in definition of the pitch of a tone by an ear of average fineness does not perceptibly increase after sixteen vibrations have occurred. The general results are regarded as confirming Helmholtz's theory of the co-vibration of tone-perceiving organs in the ear. The experiments were made with a pendulum fitted with a piece of toothed wheel, of *radius* equal to the length of the pendulum, the teeth impinging on a piece of cardboard. The continuous tone was obtained from a monochord.

THE torsion of wires of steel, iron, and copper has been recently made a subject of experiment by Herr Warburg (*Wied. Ann.*, No 5). Among other results, the statically-determined moments of torsion are found to be all smaller than those dynamically determined; and the differences rise from 1 per 1,000 for steel to 6 for iron and 28 for copper. The elastic pressures seem to increase somewhat more slowly than the deformations, the divergence being greater for copper than for iron, and for iron than for steel. No dependence of the coefficients of torsion on the tension was discoverable (within the limits of experiment). As to the properties of wires that have undergone permanent torsion, it appeared that it was only in the case of soft copper wires that, within wide limits of permanent torsion, these extend almost uniformly over the whole wire. Confining himself to copper wire, then, his experiments lead him to believe that by permanent torsion the wire becomes anisotropic, behaving, at any part, like a crystal of the rhombic system, whose axes have certain directions.

ATTENTION has been called by Herr Holtz (*Wied. Ann.*, No. 5) to an optical illusion in looking at geometrical figures, whereby they appear shorter from right to left than they really are; a square, *e.g.*, appearing more or less as a rectangle, and a circle as an ellipse. One direct consequence is that when we draw such figures according to eye-measurement, we make them too long horizontally. The reason of the illusion Herr Holtz considers to be that, in common life, we much more frequently encounter bodies than geometrical figures, and so are disposed to accept the outlines of such figures for the outlines of actual bodies. Now we see more of a body in a horizontal direction than in a vertical, because we see with two eyes, and these are in a horizontal line. The outline of a ball appears to us really as an ellipse, because, from right to left, we see more than half of the ball. When we see a true circle this seems horizontally shortened, because we take it for the outline of a ball, and if we draw a circle we unconsciously give the outline of a ball.

SOME researches by Herr Röntgen in the same line as those by Dr. Kerr, revealing a new relation between light and electricity, are described in the *Annalen der Physik*, No. 5; the methods were somewhat varied. Special attention was given to the direction of vibration of the light in the liquid, and the author's results seem in the main to confirm Dr. Kerr's views. Dr. Kerr got an effect with nitro-benzol only when a spark-interval was introduced in the connection of the one electrode with the conductor of the machine, giving a sudden discharge through the liquid. This Herr Röntgen considers due to the comparatively good conductivity of nitro-benzol; the spark discharge effects a brief but large difference of potential (not obtained in the other case), producing sudden luminosity in the field of vision. But Herr Röntgen obtained the same effect with all the badly-conducting substances he examined; it was only of longer duration. A welcome method is thus afforded for examining comparatively good conducting liquids as to electro-optic properties, and Herr Röntgen thus demonstrated, for glycerin, sulphuric ether, and distilled water, an influence of electricity on the transmitted light. The author offers (doubtfully) a different hypothesis of the phenomena to that of a direct action of electricity on the light vibration.

IN a recent paper in the *Annalen der Physik*, No. 5, Prof. Clausius criticises recently-published views of Maxwell, Frowein, and Korteweg on the mean length of path of gas molecules.

PHYSICAL SCIENCE IN RUSSIA

WE have before us the minutes of the meetings of the Physical Section during the last congress of Russian naturalists, just published in the last number of the *Journal* of the Russian Physical and Chemical Society (vol. xii., fasc. 4), and we find in them reports of several very interesting papers which were read and discussed during the congress.

The most numerous communications were on electricity. Thus, M. Fepoff exhibited the new electrophoric machines of his invention. A glass of sulphuric acid is sufficient for maintaining the machine ready, even during moist weather; it gives very powerful sparks, white and coloured, and succeeds well in decomposing water.—Prof. Khvolson made a communication on corrections to the differential equations of the motion of a magnet which oscillates under the influence of a metallic tranquilliser, and discussed the method of computation of corrections to differential equations of motion in general.—M. Tchikoleff gives the equations for determining the losses which an electrical current experiences when passing through telegraphic wires.—Prof. Stoletoff has terminated his experiments for determining the ratio between electro-magnetic and electro-static units (v of Maxwell). He undertook his experiments in 1876, but had not terminated them at that time; recently MM. Ayrton and Perry have determined the value of v by a method analogous to his own, which differs from theirs in measuring a current produced by a series of successive discharges, by means of a rotating commutator, the velocity of rotation of which is measured by means of a chronograph. The preliminary experiments have given a velocity very near to that found by other researches, *i.e.*, about 300,000 kilometres per second, and Prof. Stoletoff expects to obtain more exact figures.—M. Borgmann continues his experiments for determining the heating of iron by intermittent magnetisation. The experiments are very difficult, because of the inductive currents, but they have already shown that a change in the magnetic state produces an increase of temperature.—Prof. Lemström (Helsingfors) made a communication on his most important work on the causes of terrestrial magnetism. He has demonstrated that an annular isolator, when put in rapid rotation around an iron cylinder, acts upon this last as a galvanic current and magnetises it. Likewise an iron cylinder when rapidly rotating in an insulating medium must be magnetised, and thus the earth when rotating in an atmosphere of ether must also be magnetised. The various peculiarities observed as to terrestrial magnetism might be easily explained by the motion of the earth around the sun, and by the terrestrial galvanic currents.—M. Tchikoleff explained his improvements in the Foucault electric lamp, which allow several lamps to be placed in one circuit.—Prof. Petrushevsky made an interesting communication on his measurements of the intensity of the magnetic field between the extremities of electro-magnets of various shapes, which measurements were made for determining the best shape to give to electro-magnets. That of Ruhmkorff proved to be twice as strong as that of Gramme. The best shape is that of two iron cylinders united together by means of arcs made of broad iron plates. The free ends must be provided with two spherical pole-pieces, each of which has a conical processes, the ends of these two processes being directed one to another.

In meteorology we notice several valuable papers, the most important of them being that by M. Woeïkoff on rainfall *in*